Urban Informatics, Ubiquitous Computing and Social Media for Healthy Cities

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ABSTRACT: *The increasing ubiquity of digital technology, internet services and location-aware applications in our everyday lives allows for a seamless transitioning between the visible and the invisible infrastructure of cities: road systems, building complexes, information and communication technology, and people networks create a buzzing environment that is alive and exciting. Driven by curiosity, initiative and interdisciplinary exchange, the Urban Informatics Research Lab at Queensland University of Technology (QUT), Brisbane, Australia, is an emerging cluster of people interested in research and development at the intersection of people, place and technology with a focus on cities, locative media and mobile technology. This paper introduces urban informatics as a transdisciplinary practice across people, place and technology that can aid local governments, urban designers and planners in creating responsive and inclusive urban spaces and nurturing healthy cities. Three challenges are being discussed. First, people, and the challenge of creativity explores the opportunities and challenges of urban informatics that can lead to the design and development of new tools, methods and applications fostering participation, the democratisation of knowledge, and new creative practices. Second, technology, and the challenge of innovation examines how urban informatics can be applied to support user-led innovation with a view to promote entrepreneurial ideas and creative industries. Third, place, and the challenge of engagement discusses the potential to establish places within cities that are dedicated to place-based applications of urban informatics with a view to deliver community and civic engagement strategies.*

Keywords: *urban informatics; urban computing; mobile applications; real-time city; community engagement*

Introduction

Local governments have been seeking new strategies to move from a model of passive community consultation to modes of active community engagement. Technology innovations such as urban informatics, social media, ubiquitous computing, mobile applications, and

location based services, open up new opportunities for engaging people in critical thinking, green initiatives, and creative practices, in order to create healthy cities.

This paper introduces urban informatics as a transdisciplinary practice across people, place and technology that can aid local governments and their partners to create responsive and inclusive public spaces in the context of modern knowledge economies. Focussing on new urban spaces as examples of this, the goal of this paper is twofold: theoretical and empirical. The first part discusses three challenges:

a. *People, and the challenge of creativity*: The paper explores the opportunities and challenges of urban informatics that can lead to the design and development of new tools, methods and applications fostering participation, the democratisation of knowledge, and new creative practices.

b. *Technology, and the challenge of innovation*: The paper examines how urban informatics can be applied to support user-led innovation with a view to promote entrepreneurial ideas and creative industries.

c. *Place, and the challenge of engagement*: The paper discusses the potential to establish sites within urban spaces that are dedicated to place-based applications of urban informatics with a view to deliver community and civic engagement strategies.

The discussion of these challenges is illustrated by a review of projects as examples drawn from diverse fields such as urban computing, locative media, community activism, and sustainability initiatives.

Urban Informatics

As both technology and technological practice evolve in turn, human-computer interaction (HCI) has expanded its focus from the design and assessment of particular interaction styles to encompass the role that interactive systems play in connecting people with their world. The focus of HCI is no longer grounded by the notion of people stationarily moored to a fixed desktop computer in an organisational context. Rather, people are constructed as fluid and mobile interacting with technologies in different environments and across a broad range of contexts.

Urban informatics[1] deals with the processing of information particularly via network technologies, which comprises a wide range of urban constituents from the overall configuration of the city (such as the control and monitoring of resources through sensor networks) to the individual's day-to-day interaction with technologies (such as mobile social media and location-based services). While urban informatics shares similarities with pervasive or ubiquitous computing, it focuses specifically on urban (and peri-urban) contexts as the site of enquiry. Urban informatics takes a transdisciplinary approach to understanding the city as an ecology that consists of technological, social, and architectural layers. Following on from the remarks about urban informatics in the preface to the *Handbook of Urban Informatics* (Foth, 2009), we have now defined urban informatics as,

> "the study, design, and practice of urban experiences across different urban contexts that are created by new opportunities of real-time, ubiquitous technology and the augmentation that mediates the physical and digital layers of people networks and urban infrastructures." (Foth, Choi, & Satchell, 2011, p. 4).

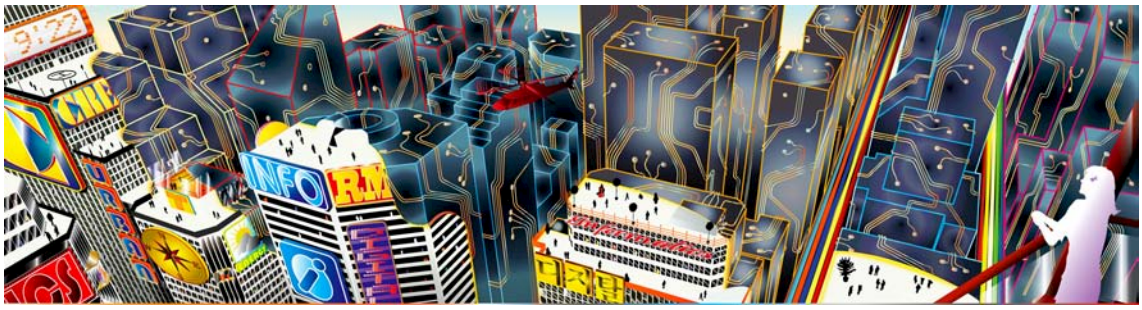

Figure 1: An artwork commissioned by the Urban Informatics Research Lab to illustrate the physical and digital layers of the city

In addition to the term 'urban informatics,' one of the most prominent descriptors is 'urban computing.' However, with its narrow focus on technology, it falls short of adequately representing the triad of people, place, and technology that makes up urban informatics research, specifically the human element: people, citizens, urban residents, city dwellers, urbanites. 'Informatics' with its implied reference to information systems and information science shifts the attention – away from the hardware and more towards the qualitative aspects of information exchange, communication and interaction, social networks, and human knowledge and creativity. Hence, urban informatics is concerned with the impact of

[1] Founded in 2006, the Urban Informatics Research Lab is a dynamic and fast growing team working across research and development at the intersection of people, place and technology with a focus on social media, ubiquitous computing and mobile applications. The lab is transdisciplinary in that it comprises and collaborates with architects with degrees in media studies, software engineers with expertise in urban sociology, human-computer interaction designers with a grounding in cultural studies, and urban planners with an interest in digital media and social networking. Being hosted by the Creative Industries Faculty, and specifically the cross-faculty research *Institute for Creative Industries and Innovation* at QUT enables the lab's projects to embrace the creative energy of a range of disciplines across design, performance, production and writing.

technology, systems and infrastructure on *people* in urban environments. This conceptualisation resonates with Mumford's (1934) use of the term 'technics' (as opposed to technologies), highlighting the active interplay between technological and social domains – or techno-social development – rather than a purely socially or technologically deterministic approach to understanding urbanisation processes and their impact on society.

Concrete examples of the outputs of the Urban Informatics Research Lab demonstrate the contributions that academic research can make to social agendas:

- **EnergyWiz**: A smart phone application to monitor and help reduce domestic energy consumption through different behavioural strategies such as serious games, comparative feedback and benchmarking.
- **Discussions in Space**: A multi-platform civic engagement application allowing city residents to participate in urban planning consultation processes via public screens, SMS, twitter and the web.
- **FixVegas**: A smart phone application that enables users to take photos of broken city assets and submit maintenance requests to local government authorities.
- **Sapporo World Window**: An interactive public screen based application that allows people to share their creativity and knowledge about places around Sapporo, Japan.
- **Dispo Maps**: A smart phone application that enables users to share their location ad hoc and temporarily with others, and then "dispose" of their location sharing data to protect privacy.
- **Capital Music**: A system that allows people in public places to publish their music and song choices.
- **PlaceTagz**: A location-based service based on QR codes that allows people to leave comments and feedback in space by anchoring the content to longitude and latitude coordinates.
- **StoryTrails**: An engaging e-book reader for smart phones that only releases chapters of a book when the reader is at specific locations that the author specified.
- **HistoryLines**: A Google Map mash-up application that visualises a residential community's migrational history and memory and allows for the sharing of experiences and encounters.

Within the last decade, interest in urban informatics research and development has increased in parallel with the heightened urgency and immediacy of key trends in the three core areas of

influence, that is, across *people*, *place*, and *technology* domains in urban environments. The following section addresses three key intellectual challenges in each of the areas of scholarship of people, place, and technology that will now be discussed in turn.

People, and the Challenge of Creativity

The urban environment is increasingly conceptualised as a complex techno-social network. The city, however, only meaningfully exists when it is occupied by a sustained stream of people. In this sense, people are the core of the city.

Google Maps and Google Earth are examples of a trend towards Geographical Information Systems (GIS) and related tools that can be used by lay persons and non-experts without intensive training. Di-Ann Eisnor of Platial Inc. coined the term 'neogeography' to describe the notion of a "geography without geographers" (Sui, 2008). This new trend describes tools and services that allow non-geographers to use advanced GIS. Similarly, our previous research work identified potential for the emergence of a 'neo-planning' paradigm in which urban planning is aided by the active engagement of everyday citizens enabled by social media and new technology (Foth, Bajracharya, Brown, & Hearn, 2009; Mallan, Foth, Greenaway, & Young, 2010; Schroeter & Houghton, 2011).

Both neogeography and neo-planning are examples of what Beer and Burrows (2007) describe as the emergence of a new rhetoric of democratisation, specifically the democratisation of knowledge. From individuals to collective entities, people are increasingly presented with new opportunities to participate, engage, and make their voice heard on a variety of issues. The proliferation of blogs and social networking sites such as *Facebook* and *Twitter* proves that media 'produsage' – referring to the convergence of production and usage as evidenced in the rise of user-led content creation (Bruns, 2008) – is becoming part of everyday social interactions. Individuals concurrently exist as constitutive nodes and users of the city as a network. Hence concepts such as *communicative ecology* – which refers to the technological and social context in which communication processes occur (Hearn, Tacchi, Foth, & Lennie, 2009) – and *network sociality* (Foth, Choi, Bilandzic, & Satchell, 2008) are pivotal to understanding urban processes today.

Many examples of how participatory culture is enabled by recent technological innovation rely on so-called 'Web 2.0' applications and services such as blogs, *Wikipedia*, *YouTube*,

Flickr, and social networking sites such as *Facebook*, which are arguably more open, collaborative, personalisable, and therefore participatory than the previous Internet experience. According to Kolbitsch and Maurer (2006), the participatory qualities of Web 2.0 encourage ordinary users to make their knowledge explicit and help a collective intelligence to develop. As Shirky (2008) observes, "here comes everybody" – by creating and leveraging collective intelligence via ICTs, the means to engage in participatory culture are no longer limited to the technically versed or the civically inclined. Scholars such as Jenkins (2006) and Burgess, Foth et al. (2006) have identified socio-technical trends towards a wider, 'vernacular' ability of people to participate in digital culture through new expressions of creativity. The implications for citizenship, and cultural citizenship, only start to be realised now. In an urban context, we have argued that vernacular expressions of creativity present diverse possibilities for network socialities to form and for a profound urban epistemology to emerge (Foth, et al., 2008; Foth, Odendaal, & Hearn, 2007).

Two examples will be discussed to illustrate the argument.

Creative Environments for Collaboration and Innovation

The first example looks at the impact of new technology and new technological practices and possibilities on work environments. Laura Forlano's research started off by examining local area wireless networks in New York and other cities around the world (Forlano, 2009). This work led to her more recent interest in the role of information technology in supporting open innovation networks in urban environments with a specific emphasis on the use of mobile, wireless and ubiquitous computing technologies to support collaboration.

Forlano and colleagues contributed "Breakout!" to the 2009 exhibition "Toward the Sentient City" (http://www.sentientcity.net) curated by Mark Shepard and organised by the Architectural League of New York (Townsend, Forlano, & Simeti, 2011). They describe Breakout! as:

> a festival of work in the city, that explores the dynamic possibilities of a single question: what if the entire city was your office? Drawing inspiration from the shared office spaces of the co-working movement, Breakout! creates alternative venues for collaborative work outside of traditional office buildings by injecting lightweight versions of essential office infrastructure into urban public spaces.
>
> Originating in Lower Manhattan, Breakout! explores the potential of public plazas and parks throughout the Financial District to serve as gathering points for workers from throughout the

> city. From this hub, organizers fan out across the city, bringing satellite "breakout sessions" to diverse public locations. During the second half of Breakout! our growing social network will "breakout of Manhattan," by turning transit into workspaces as we travel to co-working hubs throughout the region – in Westchester, Brooklyn, New Jersey and Philadelphia.
>
> Every Breakout! session provides three sets of tools to help office workers escape dull cubicles and conference rooms and re-locate their work in public settings:
>
> - Lightweight infrastructure – chairs, tables, electrical power and wireless Internet
> - Social software – a web portal accessible locally and remotely for scheduling sessions, seeing who's there, and recording their social media produced during sessions.
> - Facilitator's guides – An automated help system that will provide cues and information for session facilitators to help jumpstart collaborations and sharing, to create value and a novel work experience that takes advantage of public spaces.

Breakout! is a useful example that demonstrates how social networks and the communication and interaction applications and devices used to support these networks bring about new forms of collaboration that have the potential to spur creativity. Adkins et al. (2007) termed these cross-disciplinary, cross-organisational linkages, "ecologies of innovation." Forlano (2012) summarises the contribution that new situated mixed-media initiatives such as Breakout!, but also for example, "Jelly" (http://workatjelly.com, see Figure 2) deliver, as follows:

> Building on the experience of co-working communities, Breakout! sought to stage mobile work and co-working activities in public spaces in order to reintegrate these practices into everyday life with a belief in the potential to spur creative thinking, build new networks and take advantage of New York's natural demographic diversity. Citizens and passersby were believed to be both participants and observers in an ongoing experiment in mobile work and peer production. By considering factors such as the interplay between people, places, and technologies, the team believed that it was possible to improve individual experiences and group interactions as well as create new modes of collaboration and innovation.

Figure 2: Jelly ActionHack #26 meet-up 27 March 2011, Brisbane. Photo by Nigel: twitter @nr99

Creative Engagement of Youth in Local Planning

The Urban Informatics Research Lab conducted a study in collaboration with a local government body that included an exploratory workshop with a group of high school students using the virtual reality environment *Second Life* as a planning tool for designing a community space as part of an urban redevelopment project. The project was part of a larger study that investigated the way narrative and creative practice can be utilised in community engagement activities and realized in design ideas. The primary aim of the workshop was to trial Second Life as an immersive virtual world for stimulating the creativity of students in learning design and communication skills through play (Foth, et al., 2009; Mallan, et al., 2010).

The local government was redeveloping a site that was formerly used as a timber mill. The vision for the new site was 'to develop and sustain facilities [...] for present and future generations of the community with balanced consideration to history, culture, education, arts and economics.' The master plan of the site proposed the development of a new library

building, as well as the renovation of heritage-listed buildings that formed part of the timber mill precinct. The building of a former butter factory, which has been redesigned as a performing arts centre, is also in close proximity to the site and forms part of the overall precinct.

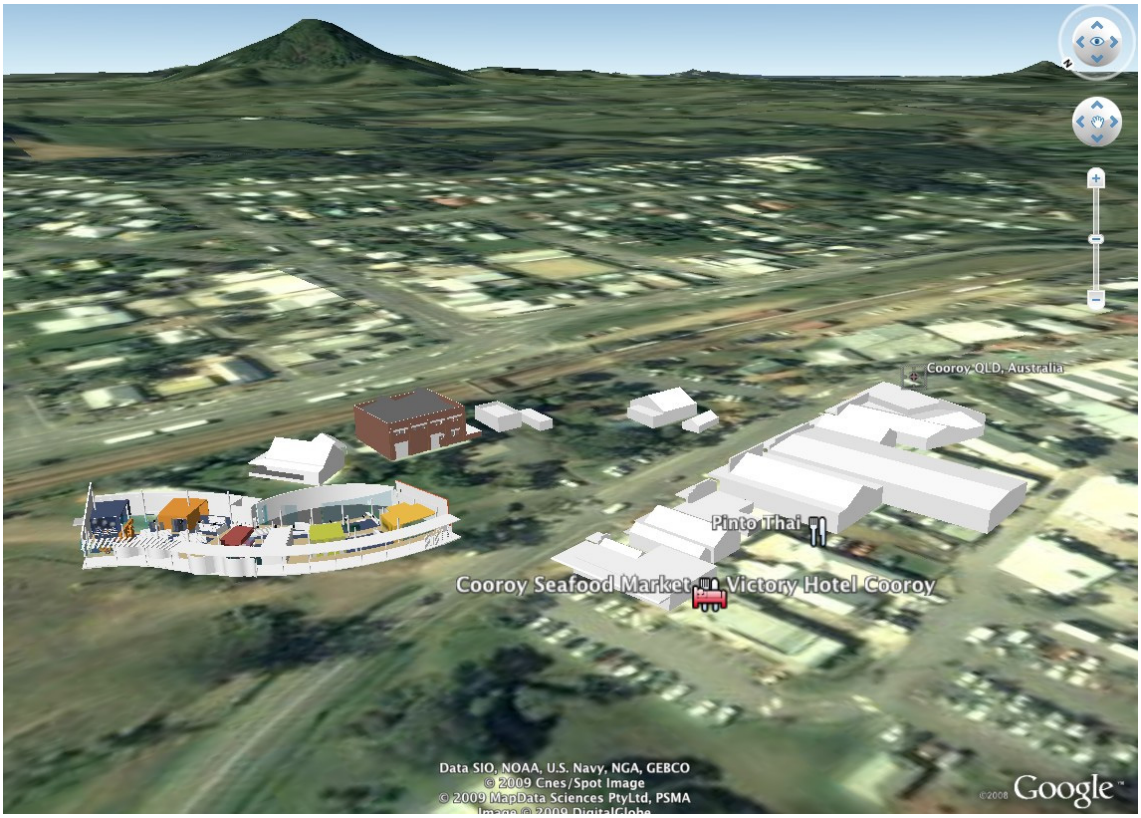

Figure 3: The model of the new library building was locally embedded in Google Earth

The study was interested in exploring new ways to engage diverse and traditionally under-represented sections of the local community, such as young people. The objective of our workshops with 20 middle school students, aged 13-15 years, was to experiment with Second Life as an interactive tool to allow them to participate in the project and contribute creative ideas and feedback for the planned development.

In preparation for the workshop, we re-constructed the precinct in its pre-development stage on a stand-alone Second Life 'island.' The class was equipped with twenty laptop computers that connected to this island. In order to give the students a sense of the spatial and other physical features of the precinct, we accompanied them on a half-day excursion to the site where they were encouraged to explore – the creek, the recently cut down camphor laurels, the woodworkers' house, the butter factory and the restored mill – to take photographs of things that interested them.

Following the half-day excursion, we began the workshop with using Google Earth to allow the students to explore the area in a more photo-realistic environment. We uploaded a 3D SketchUp rendering of the proposed library building to illustrate certain qualities of a virtual environment (Figure 3). After an initial training phase to familiarise themselves with the avatar controls that the Second Life client offers, students were asked to brainstorm creative ideas about both the current and intended usages of the three main precincts (timber mill; butter factory arts centre; library). We then focused on the outdoor areas and the greenbelt in the centre of the site, and students were asked to identify ideas and opportunities for how this space could be utilised to enhance the user experience of each of the three elements of the precinct. The class was then divided into three groups representing each one of the three sites, and each group was asked to vote on their favourite idea that was then constructed on-the-fly in Second Life.

Figure 4: A group of student avatars meet and chat ‘in-world’

The study provides some positive evidence that Second Life and a constructivist learning approach can provide a useful means for stimulating students’ creativity to be engaged in a real-world learning experience. The workshop took on a flexible learning approach providing the students with multiple opportunities to engage freely with the technology, to consider the needs of the community and to experience the precinct first-hand. Collaborative learning was

prominent in the workshop and exhibited through the students imagining creative scenarios about the site and its possible development, in role-playing as various workers at the site, making decisions about design features and site locations, and by having their avatars move around the site. This allowed them to observe aspects from a different perspective, enabling them to play the role of designers, decision makers and explorers. Foth et al. (2009) and Mallan et al. (2010) have published a more detailed analysis of this study.

Technology, and the Challenge of Innovation

The advancement of network technologies – most notably the Internet – has offered ways to augment experiences of 'place' in two contradicting ways. While wireless ubiquitous computing allows for interactivity in a *place-independent* way across physical and geographical boundaries, technologies such as mobile and locative media provide access to *place-specific* information. Movements such as 'Earth Hour' are a clear example of social networking assisted by information and communication technologies (ICTs) that can connect individuals and communities around the world to make an impact based on their shared beliefs (B&T, 2010). In the current hybrid environment, many of its constituents are becoming – if not already – the 'Internet of Things,' hinting at the potential of more inclusive interactions (also thus exclusion) amongst people and other entities that jointly constitute society. Two key trends are worthy of further exploration in this context: the ubiquity of new technology, and access to real-time information.

First, everyday technology becomes more and more ubiquitous: small, embedded and accessible anywhere, anytime (Greenfield, 2006). Bell and Dourish (2007) argue that the design and development of ubiquitous computing (ubicomp) as well as the ability to access information in places other than the conventional 'desktop,' call for a better appreciation of the 'messiness of everyday life,' which ultimately requires social and cultural research skills in addition to technical expertise. Dave (2007) compiled examples of such cross-disciplinary studies in the field of urban ubicomp, which our research tries to enrich further. The findings of both our own (Bilandzic, Foth, & De Luca, 2008; Foth, Forlano, Satchell, & Gibbs, 2012; Satchell, 2004, 2006; Satchell & Singh, 2005) as well as other research (Consolvo, Paulos, & Smith, 2007; Goggin, 2006; Kopomaa, 2004; Nyiri, 2005) corroborate our hypothesis that the mobile phone will play a crucial role in expanding the means of participatory culture in an effort to embrace and foster values of sustainability.

Second, as a consequence of widespread ubicomp deployment in urban environments such as sensor networks, locative media and mobile devices (Scharl & Tochtermann, 2007), the accessibility of real-time information enables a major transformation of the way we perceive, understand and subsequently conceive and plan city spaces (Calabrese, Kloeckl, & Ratti, 2007). Heralding the 'real-time city', Townsend (2009) writes:

> "Where we will see lots of change is in the software that shapes cities. Embedded sensing will replace a lot of human watchers, and 'watch' things on a frequency and scale we can barely imagine. But what will be important is how these abundant data streams provide a new ability to model and simulate very complex urban systems in real-time. Whereas today, urban managers and planners react on the time cycle of a census, by mid-century real-time dashboards and predictive models will rule the trade. ... If aerial photography showed us the muscular and skeletal structure of the city, the revolution in urban informatics is likely to reveal its circulatory and nervous systems."

Informing the design of real-time mobile information systems that make the invisible visible holds great potential to have wide-ranging impacts on sustainable urban development. By being mindful of these developments at the very outset of the research, as well as keeping risks in mind and avoiding to pre-empt any conclusions, the research seeks to be guided by a balanced affinity considering social, economic and environmental downsides. Ubicomp applications and devices require electricity, one of the main causes of greenhouse gas emissions; in Australia the combined domestic and workplace usage accounts for one fifth of total national emissions (Climate Risk, 2007, p. ix). However, as noted in the Stern (2007) report, removing 'barriers to behavioural change' (McKenzie-Mohr, 2000) is one of the essential elements in advancing opportunities for energy efficiency. Our work in this area, bringing real-time environmental data into the homes and hands of the city dwellers via ubiquitous computing, finds vast potential for positive feedback and learning to better understand the impact of personal and collective habits.

In the face of these trends, as well as the continued and accelerated crisis in environmental, economic and social sustainability, a number of trends informs our work in urban informatics and specifically the possible role of community engagement in contributing to enhancing urban sustainability:

i. Changes in the public sphere in terms of participation, online deliberation systems, polity of urban futures;

ii. The possible use of user-generated content for urban planning (paralleling the rise of user-generated content in other domains);

iii. The related role of social networking, collective and civic intelligence, and crowd-sourcing in urban futures;

iv. The rise of technologies such as wireless Internet and mobile applications, and the impact of neogeography, simulations and 3D virtual environments that reproduce and analyse complex social phenomena and city systems in urban futures, design and planning.

Ushahidi.com

We recently compiled an edited book, *From Social Butterfly to Engaged Citizen: Urban Informatics, Social Media, Ubiquitous Computing, and Mobile Technology to Support Citizen Engagement*, (Foth, et al., 2012). It provides strong empirical evidence from an international group of authors to show that applications of social media and mobile technology have left the purely 'social' realm causing real impact in terms of community activism, civic engagement, cultural citizenship, and user-led innovation.

In our book, Hirsch (2012, in press) discusses ushahidi.com, an incident-reporting system developed during Kenya's post-election violence in 2007 that combines citizen journalism with map visualisations (Figure 5). He argues that,

> "most of the current literature on activist use of social and mobile media focuses on what activists can do with commercial services, it tends to overlook what they cannot do. That is to say, analysts who study activist appropriation of services like Facebook and Twitter often miss the ways activist needs outstrip the capabilities that these services offer. I suggest that examining activist alternatives to commercial social and mobile media services provides valuable insights both into the technology design and into the nature of contemporary advocacy movements."

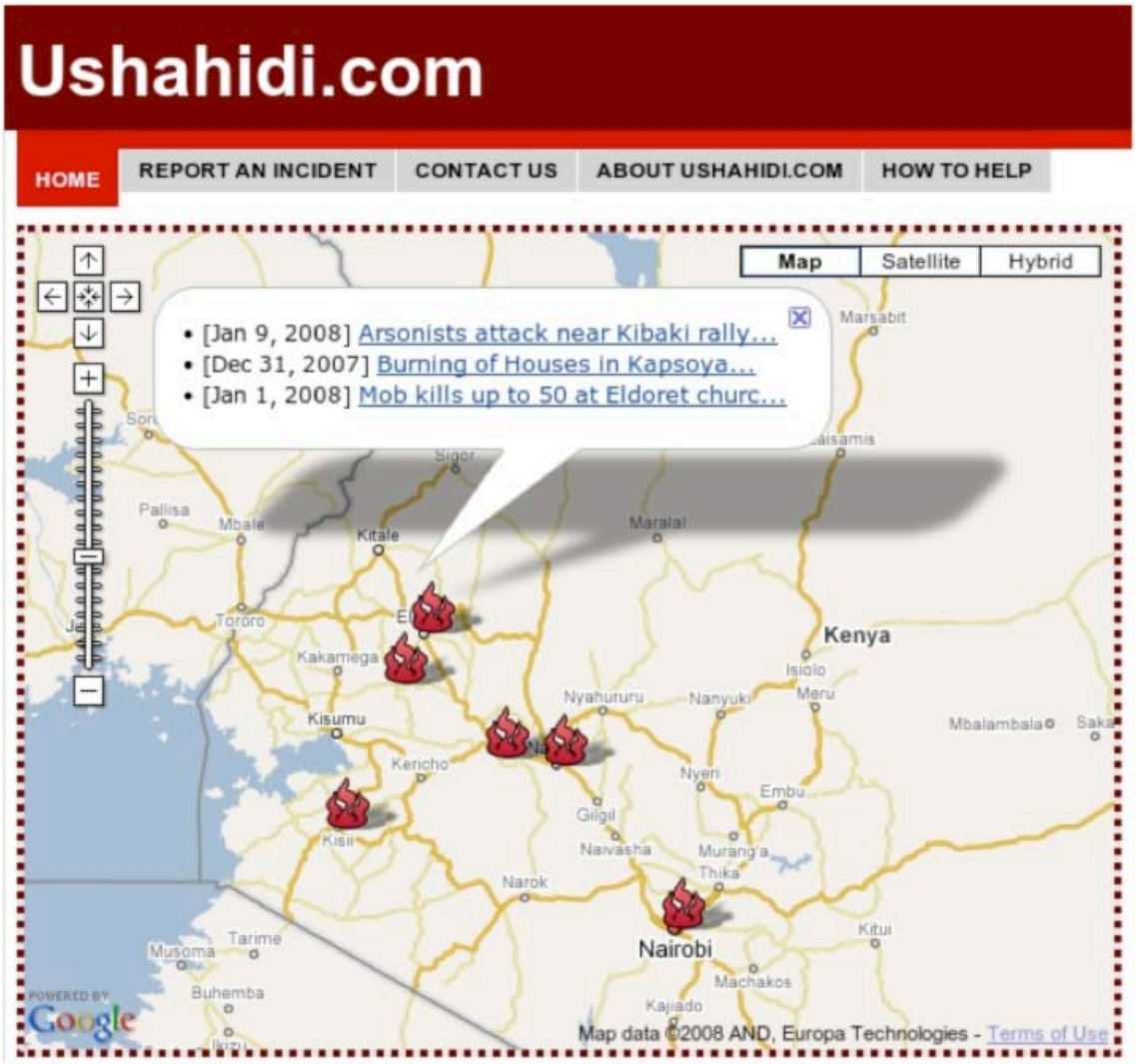

Figure 5: ushahidi.com – screenshot by Hirsch (2012, in press)

Hirsch's argument corroborates the significance of our goal to examine the limitations to merely appropriating existing off-the-shelf ICT solutions with a view to identify opportunities to create purpose-made design innovations that are informed by and further support user-led innovation.

Citizen Science

A further example of user-led innovation was highlighted by Paulos and his colleagues as part of their ongoing research program into participatory urbanism, DIY (Do-It-Yourself) culture and citizen science (Paulos, Honicky, & Hooker, 2009; Paulos, Kim, & Kuznetsov, 2012). Paulos and his team recruited taxi drivers in Accra, Ghana to participate in a study to collect air quality data.

We chose Accra because of its poor air quality and common practice of domestic cooking outside using wood, charcoal, and other biofuels. … Each taxi driver was provided with a dash mounted GPS logger and a tube to hang from their passenger window that contained a carbon monoxide sensor, and a sulfur dioxide or a nitrogen dioxide sensor. At the end of each day, the sensor tube was dropped off at a convenient location where the data was extracted and the sensors charged. … Over the two-week period we collected an impressive and diverse collection of air quality data, revealing dynamic ranges of air quality across neighborhoods and over time. Looking only at CO, for which safe levels are defined as 9 ppm for 8 hours and 35 ppm for 1 hour, our participants logged frequent readings around 30 ppm with many samples ranging up to 75 ppm and some as high as 200 ppm. A heat-map visualizing only the CO values over one 24-hour period captures the dynamic range of air quality across the city as never before seen (Figure 6).

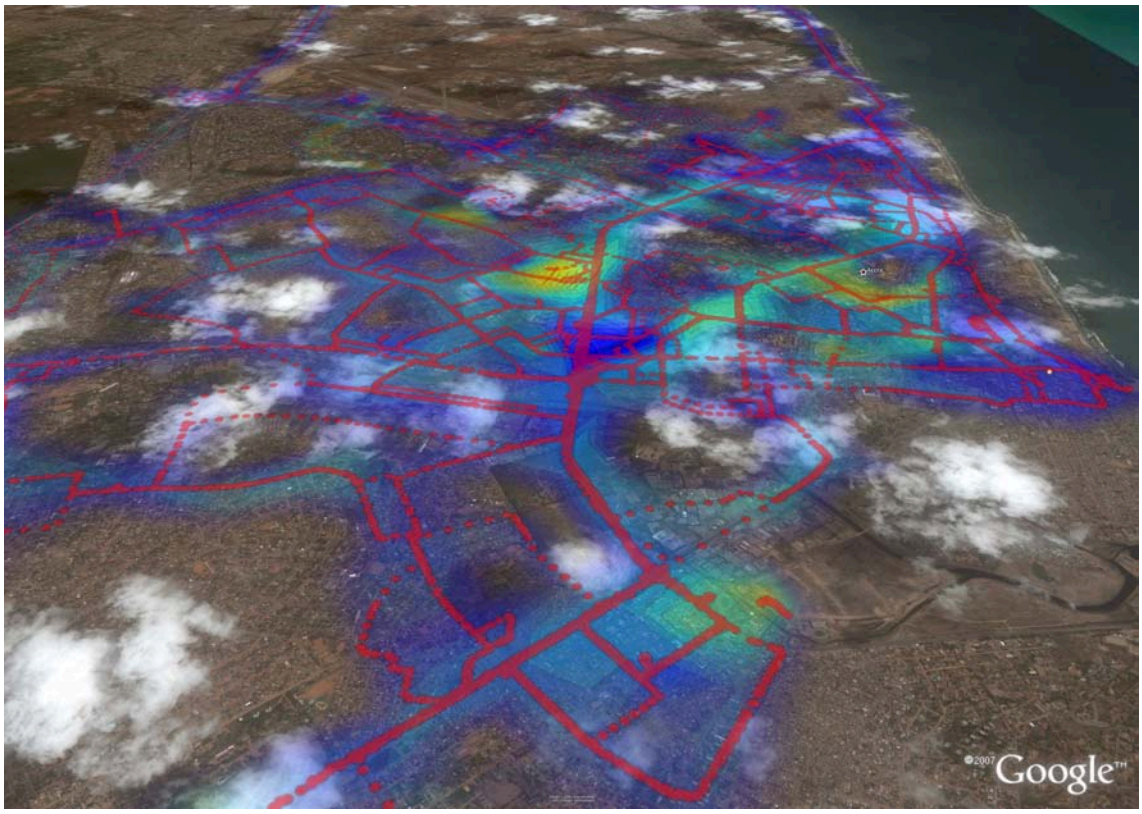

Figure 6: A heat-map visualization of carbon monoxide readings across Accra, Ghana rendered atop Google Earth. Colors represent individual intensity reading of carbon monoxide during a single 24-hour period across the city. Red circles are locations were actual readings were taken. Photo by Paulos, et al. (2009)

While the rich data sampled from our two-week study in Accra provided hard evidence for the need for citizen science air quality sampling, there were even more revealing and unexpected social effects that resulted. Recall that we provided the participants only with the technology and instructions to carry it during their everyday activities. At the end of each day they dropped of the gear where it was charged and the data extracted. When we conducted exit interviews, it was clear that, although it was not our intention to provide any humanly readable output on the devices, the participants had begun to look at the numbers and piece together a personal view of the areas of toxic air across Accra. Many discussed how they watched to see how parts of their city changed as they travelled through neighborhoods at different times of day and how they discussed air quality and passed on their new knowledge of hazardous locations to their friends and family. Subjects who thought about air quality once every few months before the study

> were now thinking about it hourly. Even more interesting, our subjects reported changing their routes through the city, choosing different times to travel downtown, walking further from roadways, being outside later in the day rather than during high pollution times, and even taking their own automobile in for inspection to insure they were not contributing to the problem they were measuring. Several of the participants encountered each other when dropping of their equipment for charging and, although they did not know each other, many of them reported discussing the data they were measuring each day, where they had captured dangerously high readings, alternate routes they had found to be less polluted, and compared graphs from each day's journey.
>
> Most participants reported that the most important thing they learned from the study was that there were extremely unsafe levels of air quality in their city beyond what any government or news agency had reported to them before. Many expressed anger and distrust in their civic leadership for not informing them of such a hazardous condition nor enacting legislation to improve it in the name of public health. Remember, there was no formal networked, real-time sharing mechanism or informed interface for this study and yet spectacular elements of citizen science emerged. (Paulos, et al., 2009)

The air quality sensors provided by the study were adopted by the participants who started to learn how to interpret the displayed values and change their behaviour and actions accordingly. Paulos' case is an example of user-led innovation, that is, a practice of products and services being re-appropriated, re-developed or refined by users during use (von Hippel, 2005).

Place, and the Challenge of Engagement

Simmel's observation of the rising metropolitan life in Europe at the beginning of the 20th century was that:

> "[t]he relationships and affairs of the typical metropolitan are usually so varied and complex that without the strictest punctuality in promises and services the whole structure would break down into an inextricable chaos" (Simmel, 2004).

The thin veneer holding together urban infrastructures has become more fragile in recent years with an epochal shift in urban densification across the globe. More than half of the entire global population now lives in cities. The UN Population Fund (UNFPA, 2007, p. 2) predicts that urban populations will grow even further to reach 60% of the entire global population by 2030. Thus planning, developing, and experiencing various infrastructures of the city, including social and technological, are becoming increasingly complex. I previously argued (Foth, 2009) that such complexity necessitates a *real-time* examination with flexibility in macro-/microscopic perspectives in order to account for both tangible and intangible urban constituents that occupy the 'hybrid space' (De Souza e Silva, 2006) between the physical and

digital. Urban informatics as a scholarly domain offers useful research apparatuses for this type of real-time examinations.

Townsend (2009) argues that:

> "the timing is certainly right. Urban planning is well into an undeclared crisis of thought leadership – despite it being one of the best avenues for dealing with global challenges like climate change and migration. Information science is poking its head out of the burrow and seeing the enormous intellectual challenge of expanding what worked on the desktop of the elites, to a diverse and mobile urban population."

Townsend refers to two trends: First, decision making support for the variety of situations and the diversity of people in cities requires the information sciences to deliver complex modelling and simulation tools for urban planners which they can use to represent the many aspects of the behaviour of cities and their inhabitants, including transport, utilities, facilities, and the environment. It is hoped that such tools can assist with rational decision making about future developments and improve resource management whilst considering the diversity of urban contexts and environmental factors. However, secondly, such tools should not stay just in the hands and power of professionally trained urban planners. Similar to the way Web 2.0 tools and services have brought about a more participatory Internet experience, neogeography and related innovation in the *place* domain need to ensure the products of the information sciences deliver access, usability and usefulness tailored to *"a diverse and mobile urban population"* rather than elite experts only.

It is important to consider that "The City" as a conceptual category and abstract intellectual notion is an intriguing but also dangerously complex entity to such an extent that its merits on this broad and encompassing level may not even be useful. Williams, Robles, and Dourish (2009) unpacked the assumptions underpinning "The City" in a lot of urban informatics research and found a dense ecology of impersonal social interactions occurring within recognisably public places. They argue for a heightened awareness that accounts for local particularities between cities as well as the broader global networks of connection between these sites.

Mobile phones have become a well-established communication device in the everyday lives of many people. Their promise is to connect us to anybody, from anywhere at anytime. Mobile communication has contributed to a shift of people's role towards 'networked individuals' in urban environments (Wellman, 2001, 2002); our person-to-person relationships have become more complex affording a seamless transitioning between being

physically present at a particular place and being digitally connected at all times. Mobile media support people not only to connect to distant others, but also to coordinate and initiate social interactions in their physical proximity, e.g. spontaneously organising collective actions (Rheingold, 2002). This is supported by Gordon and de Souza e Silva (2011) who have recently published a book-length account that provides strong evidence from various sources and perspectives to confirm that place continues to matter in a networked world:

> "The local still matters, and in fact, it may matter more than ever before because it can have an immediate and powerful global impact." (p. 168).

The potential of this impact led some local governments to embark on exploring what difference *place* can make to new technological practices and new engagement strategies (Freeman, 2005). Such explorations include social networking, user-generated content creation and curation, crowd sourcing, etc. However, the strategic direction is still mostly experimental, scattered and patchy.

Discussions in Space

The Urban Informatics Research Lab is leading the development and trial of a public consultation tool specifically designed for urban planning that we call Discussions in Space. It serves to illustrate the challenge of place-based engagement.

Discussions in Space (DiS) is a project offering an additional, experimental channel to engage with Brisbane residents as part of a Brisbane City Council (BCC) urban planning project, which requires a consultation phase with Brisbane residents. The DiS project facilitates a public civic discussion and opinion forum through the installation of a large public screen, which passers-by can interact with using their mobile phone's SMS, Bluetooth, camera and Internet capabilities. The installation promotes civic topics, issues and questions and invites the general public to submit their opinion to the publicly visible screen, hence providing a platform for collective expression and public discourse amongst Brisbane residents. Collaborative and distributed editing and censoring capabilities ensure that the content reflects the norms and values of the installation providers, namely the university partner and the Brisbane City Council.

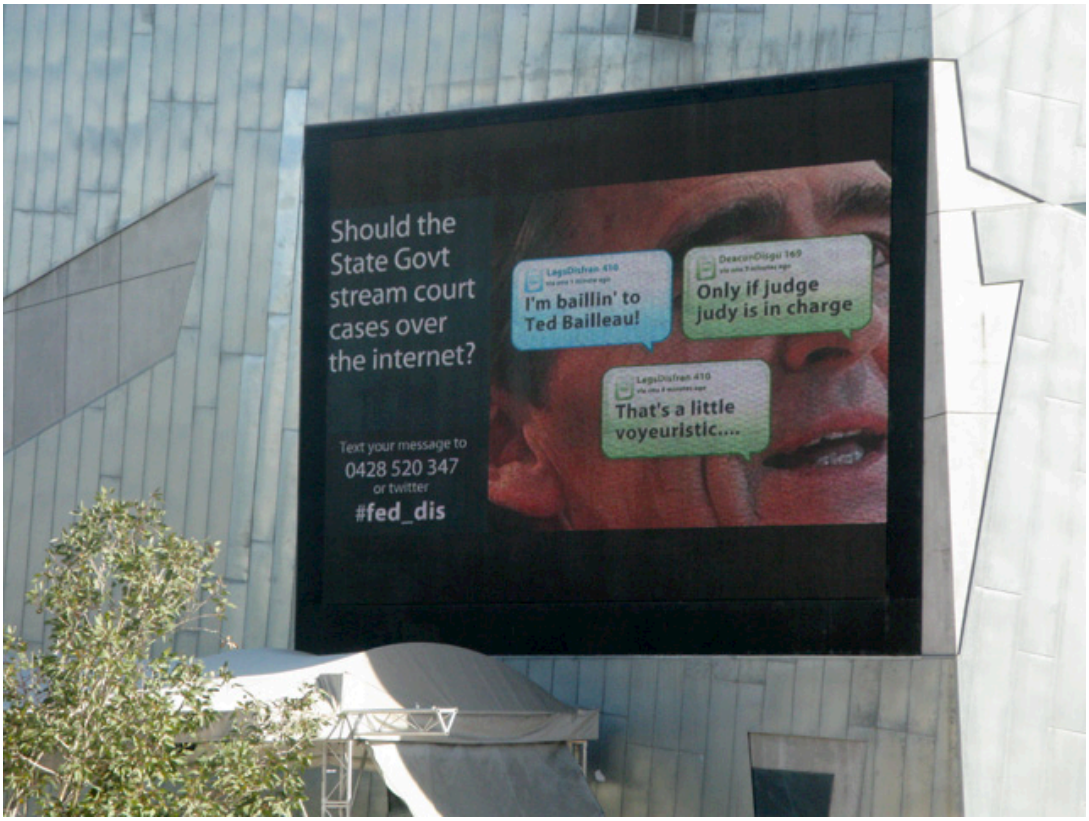

Figure 7: Discussions in Space running on the big screen at Federation Square in Melbourne

The project provides and investigates forms of in-place digital augmentation, which refer to the ability to enhance the experiences of citizens in physical spaces through digital technologies that are directly accessible within that space. This can take place in many forms and ways, predominantly through location-aware applications running on the individuals' portable devices, such as mobile phones, or through large static devices, such as public displays, which are located within the augmented space and accessible by everyone.

The hypothesis of this research project is that in-place digital augmentation, in the context of civic participation, where citizens collaboratively aim at making their community or city a better place, offers significant new benefits compared to conventional online forums or wikis – as used today. For instance, it allows a wide range of urban dwellers to access services and information and to engage with each other, where and when it is mostly needed, in place. Currently, such in-place access or engagement is either not available at all or too cumbersome to reach.

Our study is specifically interested in system designs that effectively engage with residents who councils generally have difficulties to engage with, as indicated by interviews with urban and neighbourhood planners. BCC refers to these demographics as "backyard buddies" (the

not interested and involved, transient, younger residents) and "loyal locals" (the time poor professionals and young families who might have some emotional connection to their neighbourhood as new home owners). In contrast to the third group, the "neighbourhood guardians" (older residents who have been living in the same area for many years), these two groups either do not care enough to engage on their own accord and co-create their urban environment or, although interested, they simply do not find the time in their busy lifestyles to visit time-consuming community consultation events.

Our initial user study with residents in Melbourne and Brisbane (Satchell, Foth, Hearn, & Schroeter, 2008) aligns with these findings of interviewing members of the council. Discussions in Space was developed as part of an ARC Linkage research grant in collaboration with Brisbane City Council's neighbourhood planning team (Schroeter & Foth, 2009; Schroeter & Houghton, 2011). It was installed at the Royal Brisbane Hospital, QUT Gardens Point, QUT Kelvin Grove, Brisbane Square, and the State Library of Queensland. It was also used for community engagement purposes at the OZCHI 2009 conference, the Workforce Innovation conferences 2010 and 2011, at the opening of The Edge (State Library of Queensland), and at Federation Square, Melbourne (Figure 7).

The triad of the Urban Informatics paradigm – people, place, and technology, has proven to be a simple but powerful way to conceptualise the thinking that guides the research and development work in the lab. Significant trends such as the rise of a participatory culture, social networking applications, Web 2.0 services, the increasing ubiquity of mobile technology and real-time sensor networks, and neogeography, amongst others, have contributed to the timeliness of this research work that is grounded in a variety of real-world contexts and applications. We now turn to a case study that illustrates some of this discussion and incorporates elements of urban informatics, knowledge economy, digital culture in a prototype engagement space led by a library.

Conclusions

Healthy cities do not come about just by the virtue of physically and physiologically healthy urban residents. The health of a city also relates to associated factors such as air and water quality, food access and security, building standards, social relationships, cultural activities, entrepreneurial support, infrastructure provisions, green environments, government

leadership, etc. Rather than the superficial tectonic view of a city, the term 'healthy' gives rise to a very organic notion – a picture that I introduced in the Preface to Foth (2009) to pose a number of open-ended questions:

> Cities are indeed living organisms. They are alive with movement. A rapid flow of exchange is facilitated by a meshwork of infrastructure connections. Transport grids, building complexes, information and communication technology, social networks and people form the bones, organs, muscles, nerves and cell tissue of a city. Studying the organisation and structure of these systems may seem straightforward at first, since there are visible appearances and tangible objects that we can observe and examine. We can count the number of cars on the road, the number of apartments in a building, the number of emails on our computer screens and the number of profiles on social networking sites. We could also qualify these observations by recording the make and model of cars, the size and price of apartments, the sender and recipient of emails and the content and popularity of online profiles. This approach would potentially produce a large amount of data and render a detailed map of various levels of a city's infrastructure, but a large quantity of detail does not necessarily result in a great quality (and clarity) of meaning. How do we analyse this data to better understand the 'city' organism? How do the cells of the city cluster to form tissue and organs, and how do various systems communicate and interact with each other? And, recognising that we ourselves are cells living in cities as active agents, how do we evaluate the effectiveness and efficiency of the processes we observe in order to plan, design and develop more livable cities?

Urban informatics fosters the artful integration of *culture* and *technology* in a place-based context. This presents a key endeavour in the ongoing process of creating and nurturing healthy cities, and there are and will be plenty of open, unanswered research questions such as those mentioned in the citation above that require new knowledge, new theories, and new methods. Concepts such as crowd sourcing, neogeography (Foth, et al., 2009), neoplanning (Schroeter & Houghton, 2011), collective intelligence (Shirky, 2008), civic intelligence (Schuler, 2009), citizen science and participatory urbanism (Paulos, et al., 2009), feature prominently in urban informatics research and practice. The examples and insights presented in this paper are hoped to benefit urban designers, urban planners and local governments in a way that will help them renew their objectives for the present and their vision for the future to better interact with for instance, youth and young people for the purpose of civic engagement, social change and community action. The digital generation – both young and old – is already apt to create, remix, manipulate, control, play, identify themselves, express their taste, their beliefs, political affiliations, their aesthetics, their sexuality and humor via their digital representations, social networks, and real-world interactions. The experience of our lab indicates that this new generation of Australians – often falsely accused of being apathetic and disengaged – is entering, advancing and leading political and social debate using new technological applications that allow them to incorporate their viewpoints as an integral part of society. Being at the forefront of this research and development will ensure that local

governments, urban planning and policy, and the economy more broadly continue to support and contribute to a diverse and vibrant socio-cultural life in Australia.

This paper sought to provide an introductory overview of urban informatics and the underlying principles and theories that inform research and development in this dynamic and transdisciplinary field of inquiry. It also sought to highlight opportunities for some of the insights that are emerging from urban informatics research to be taken up by leaders of other disciplines and sectors, specifically urban design, planning and policy. We are only witnessing the early beginnings of this new economic paradigm that produces innovation and in turn, wealth and prosperity, through digital media, creativity, and online networks.

It will be essential to be proactive about how these key trends will unfold and what impact they will have on cities, urban and peri-urban environments, regions, and the wider economy. Being proactive means not to sit back and wait, but to take risks, explore, and experiment in order to gauge how some of these trends can benefit our collective ability to move society forward, and what role each sector, each entity, each person can play in this new environment. Some of these key trends, chief insights, meaningful learnings that warrant further exploration on a case by case basis.

Urban informatics is situated at the hub of new technological innovations as well as new technological (user-led) practices that have already triggered some significant changes in the way we work and play. The conventional 9 to 5 roster is less and less useful to meet today's business needs. Global connectivity across time zones requires us to deal with collaborators on the other side of the planet who wake up when we go home, and who will send their work packages of the day overnight when we come back to work the next morning. Furthermore, social media and mobile devices allow us to switch between different roles seamlessly. We can receive a text message from our children at work in our role as parent, respond to an email from a work colleague the next minute, and then accept a friend request from a long lost high school mate. The prejudice that this mixing of work and leisure may be counterproductive is mostly unfound for several reasons. First, the same mix of work and play usually creeps up on us and continues at home, when for instance, work emails are being answered after hours. Second, maintaining and expanding our social network can have profound professional benefits as the nodes at the edges of our social ties help us to increase the level of diversity of knowledge and experiences that we can tap into. This in turn leads to heterogeneous structures of social capital that may be dormant for a long time, but that can be activated when

needs be. The advantages of these communicative patterns can be replicated for the purpose of informing new governance structures, too. Engagement, participation, shared responsibility and ownership, and motivational tools have already been explored for political campaigns (Obama 2.0), for environmental sustainability, and health purposes. It will be a natural next step to also investigate their utility for new governance and communication practices in organisational contexts of local governments and city administrations.

Urban informatics is all but one of the key ingredients that form the cutting edge of new knowledge production and exchange. Rather than sticking to the actual objects of inquiry, in this case, digital media technology used in urban environments, this paper sought to shed light on the meta level of analysis that looks at the underlying principles and practices and how they may be applied or transferred to other disciplines or areas of practice. Such transfers of experiences, insights and findings do not happen without some tacit knowledge being lost, and some noise being added in the process. However, if open-minded partners can be found that help to maintain an ongoing dialogue, it will be possible to stimulate a cross-disciplinary exchange of knowledge with a real chance to activate new inputs, stimulate innovative thinking, and create thought leaders for the future.

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